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POLLEN MORPHOLOGY OF SOUTH AFRICAN MALVALES: 1. CHARACTERISTICS USEFUL FOR KEYING AND FOR NUMERICAL ANALYSIS

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ABSTRACT

Simple techniques for the preparation of pollen from herbarium material, applicable to optical and scanning electron microscopy, are given. Quantitative and qualitative characteristics, as well as certain calculated values useful during construction of a key as well as in numerical analysis of pollen, are mentioned. A synoptical key to the South African species of the Malvales, based on pollen morphological characteristics, is given.

UITTREKSEL

STUIFMEELMORFOLOGIE VAN SUID-AFRIKAANSE MALVALES: 1. KENMERKE BRUIKBAAR BY SLEUTELVORMING EN NUMERIESE ANALISE

Eenvoudige metodes vir die preparering van stuifmeel van herbariummateriaal, toepaslik by ligmikroskopiese sowel as aftaselektronmikroskopiese ondersoek, word gegee. Kwantitatiewe en kwalitatiewe eienskappe, asook sekere berekende waardes wat bruikbaar is by die konstruksie van 'n sleutel en in numeriese analise van stuifmeel, word genoem. 'n Sinoptiese sleutel tot die spesies van die Suid-Afrikaanse Malvales word gegee.

1. INTRODUCTION

During a study of the pollen of the South African representatives of the Malvales, it became obvious that numerical methods would be necessary for processing of the data obtained. This was necessary because of the size of the data matrix (> 350 species or taxa of lower rank and a total of > 60 characteristics). Another reason for such analysis is the europalynous nature of the group with pollen size, number and position of apertures and spinulosity all varying within wide limits.

The optical and the scanning electron microscope were used to obtain quantitative and qualitative data from nearly all the local species of this order.

A survey was undertaken to find all possible characteristics which could be used in such an analysis. Due to practical considerations, some of these attributes

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could not be determined in all South African representatives of the order. The pollen characteristics used, and presented here, are therefore only those of which the state could be determined in all available specimens.

2. MATERIAL AND METHODS

2.1 *General*

Owing to the large number of specimens investigated, collection of pollen from specimens in the field was not possible for practical reasons, therefore all pollen was obtained from herbarium specimens filed in the collection of the South African Botanical Research Institute (PRE). Pollen from two or more representatives of each species was studied in most of the cases. In some instances, however, a single specimen only was available and no pollen could be obtained from a limited number of species which were represented only by vegetative herbarium specimens. These species were omitted from this study. Ten pollen grains from each representative were usually studied. Jones & Newell (1948) found that measurements obtained from ten grains usually do not differ appreciably from measurements obtained from as many as 100 grains.

Anthers, the floral column, or, in the case of very small flowers, all the parts of selected flowers were removed from herbarium sheets and prepared for microscopy. Where more than one example of a species or taxon of lower rank is given in the list, the pollen of the sampled specimens differed so much from each other that they had to be entered into the key as separate taxa.

All sampled herbarium sheets were identified by affixing a label stating that pollen samples were removed. Where more than one herbarium sheet of a species was sampled, one was chosen as voucher specimen.

A revision of the Southern African Malvales is in progress for the *Flora of Southern Africa*, but this work has not yet been published. The identity of most of the investigated taxa are according to this revision.

The taxa are arranged according to Hutchinson (1967), but with the genera and species in alphabetical order.

2.2 LIST OF INVESTIGATED TAXA

(Voucher specimens in PRE)

TILIACEAE

Tribe: Enteleeae

1 *Corchorus angolensis* Exell & Mendonca *De Winter & Leistner 5232*
2 *C. asplenifolius* Burch. *Codd 8460*
3 *C. capsularis* L. *n.c. 13847*

4 *Corchorus confusus* Wild *Rogers 4863*
5 *C. junodii* (Schinz) N.E.Br. *Edwards 1673*
6 *C. kirkii* N.E.Br. *Louw 794*
7 *C. longipedunculatus* Mast. *Van der Schijff 3054*
8 *C. merxmuelleri* Wild *Giess 1620*
9 *C. olitorius* L. *Melle 14258*
10 *C. pinnatipartitus* Wild *Brueckner 154*
11 *C. schimperi* Cufod. *Meeuse 10645*
12 *C. sulcatus* Verdoorn *Acocks 1445*
13 *C. tridens* L. *Maguire 2427*
14 *C. trilocularis* L. *Mordaunt 1*
15 *C. velutinus* Wild *Acocks 16767*

Tribe: Sparmannieae

16 *Sparmannia africana* L.f. *Thode A750*
17 *S. ricinocarpa* (Eckl. et Zeyh.) Kuntze *Scheepers 585*

Tribe: Grewieae

18 *Grewia avellana* Hiern *De Winter 3765*
19 *G. bicolor* Juss. *Codd 8903*
20 *G. caffra* Meisn. *Ward 646*
21 *G. falcistipula* K.Schum. *De Winter & Wiss 4396*
22 *G. flava* DC. *Acocks 1394*
23 *G. flavescens* Juss. var. *flavescens* *Ross 2003*
24 *G. flavescens* Juss. var. *olukondae* (Schinz) Wild *Story 6486*
25 *G. hexamita* Burrett *Letty 53*
26 *G. hispida* Harv. *Edwards 1025*
27 *G. inaequilatera* Garcke *Acocks 16792*
28 *G. lasiocarpa* E.Mey. ex Harv. *Galpin 3450*
29 *G. microthyrsa* K.Schum. ex Burrett *Ward 3833*
30 *G. monticola* Sond. *Harbor 17031*
31 *G. occidentalis* L. *Sidey 3842*
32 *G. pachycalyx* K.Schum. *Curzon 93*
33 *G. retinervis* Burrett *De Winter 4212*
34 *G. robusta* Burch. *Britten 5505*
35 *G. rogersii* Burtt Davy & Greenway *Galpin 133140*
36 *G. schinzii* K.Schum. *Snitler B97*
37 *G. subspathulata* N.E.Br. *Codd 8904*
38 *G. sulcata* Mast. *Codd & De Winter 5533*
39 *G. tenax* (Forsk.) Fiori *Pole Evans 35927*
40 *G. vernicosa* Schinz *Prosser 1816*
41 *G. villosa* Willd. *Ross 2006*

Tribe: Triumfetteae

42 *Triumfetta angolensis* Sprague & Hutch. *Galpin 2253*
43 *T. annua* L. forma *annua* *Mogg 612*
44 *T. annua* L. forma *piligera* Sprague & Hutch. *Mogg 14988*
45 *T. pentandra* A.Rich. *De Winter & Marais 4608*
46 *T. pilosa* Roth var. *effusa* (E.Mey. ex Harv.) Wild *Acocks 13328*
47 *T. pilosa* Roth var. *tomentosa* Szyszyl. ex Sprague & Hutch. *Codd 5356*
48 *T. rhomboidea* Jacq. *Wells 1241*
49 *T. sonderi* Fical. & Hiern *Theron 1001*
50 *T. tomentosa* Boj. *Boss 36495*

51 *Triumfetta welwitschii* Mast. var. *hirsuta* (Sprague & Hutch.) Wild *Compton 26151*
52 *T. welwitschii* Mast. var. *welwitschii* *Meeuse 10270*

STERCULIACEAE

Tribe: Dombeyeae

53 *Dombeya autumnalis* Verdoorn *Verdoorn 2470*
54 *D. cymosa* Harv. *Strey 6709*
55 *D. kirkii* Mast. *Van der Schijff 3045*
56 *D. kirkii* Mast. *Van der Schijff 3810*
57 *D. pulchra* N.E.Br. *Clarke 55*
58 *D. rotundifolia* (Hochst.) Planch. var. *rotundifolia* *Moll 1905*
59 *D. rotundifolia* (Hochst.) Planch. var. *velutina* Verdoorn *Strey 2328*
60 *D. tiliacea* (Endl.) Planch. *Strey 6608*
61 *Melhania acuminata* Mast. *De Winter 3788*
62 *M. albicans* Bak.f. *Sidey 2473*
63 *M. burchellii* DC. *Basson 98*
64 *M. damarana* Harv. *Seydel 1382*
65 *M. didyma* Eckl. & Zeyh. *Codd & Verdoorn 10175.*
66 *M. didyma* Eckl. & Zeyh. *Strey 6146*
67 *M. forbesii* Planch. ex Mast. *Mauve 4324*
68 *M. griquensis* Bolus *Story 6224*
69 *M. integra* Verdoorn *Mauve 4790*
70 *M. prostrata* DC. *Codd & Verdoorn 10373*
71 *M. randii* Bak.f. *Verdoorn 2501*
72 *M. rehmannii* Szyszyl. *Leistner 1998*
73 *M. suluensis* Gerstner *Ward 4130*
74 *M. transvaalensis* Szyszyl. *Brueckner 246*

Tribe: Hermannieae

75 *Hermannia abrotanoides* Schrad. *Dinter 3498*
76 *H. affinis* K.Schum. *Leistner 891*
77 *H. alnifolia* L. *Kruger 2*
78 *H. althaeifolia* L. *Marsh 1269*
79 *H. althaeoides* Link *Thompson 920*
80 *H. amabilis* Marloth ex K.Schum. *Goyns 58*
81 *H. amoena* Dinter ex Holzhammer *Lavranos 11034*
82 *H. angolensis* K.Schum. *De Winter 2847*
83 *H. angularis* Jacq. *Mauve 4696*
84 *H. antonii* Verdoorn *Codd 2700*
85 *H. argillicola* Dinter ex Holzhammer *Leistner 1858*
86 *H. aspera* Wendl. *Schlieben 12454*
87 *H. betonicifolia* Eckl. & Zeyh. *Louw 365*
88 *H. boraginiflora* Hook. *Bolus 10832*
89 *H. brachymalla* K.Schum. *Wilms 117*
90 *H. bryoniifolia* Burch. *Schweickerdt 2524*
91 *H. burchellii* (Sweet) Verdoorn *Acocks 2072*
92 *H. cernua* Thunb. *Hanekom 1083*
93 *H. coccocarpa* Kuntze *Badenhorst 47*
94 *H. comosa* Burch. *Cook (16.9.1967) s.n.*
95 *H. comosa* Burch. *Acocks 218*
96 *H. complicata* Engl. *Jensen 128*
97 *H. concinnifolia* Verdoorn *Foley 11*
98 *H. confusa* Salter *Marsh 857*

99 *Hermannia conglomerata* Eckl. & Zeyh. *Jessop 732*
100 *H. cristata* H.Bol. *Strey 7697*
101 *H. cuneifolia* Jacq. var. *cuneifolia* *Acocks 23995*
102 *H. cuneifolia* Jacq. var. *glabrescens* (Harv.) Verdoorn *Hanekom 920*
103 *H. damarana* Bak.f. *Mason & Boshoff 2507*
104 *H. decipiens* E.Mey. ex Harv. *Acocks 20497*
105 *H. decumbens* Willd. ex Spreng. *Esterhuisen 2962*
106 *H. denudata* L.f. var. *denudata* *Zeyher 115*
107 *H. denudata* L.f. var. *erecta* (N.E.Br.) Burtt Davy & Greenw. *Galpin 1346*
108 *H. depressa* N.E.Br. *Pegler 923*
109 *H. desertorum* Eckl. & Zeyh. *Hall 3631*
110 *H. diffusa* L.f. *Pillans 8626*
111 *H. disermifolia* Jacq. *Bolus 6671*
112 *H. disticha* Schrad. *Theron 2081*
113 *H. diversistipula* Presl ex Harv. var. *diversistipula* *Smith 3200*
114 *H. diversistipula* Presl ex Harv. var. *graciliflora* Verdoorn *Marsh 935*
115 *H. elliottiana* (Harv.) K.Schum. *Rusch 7967*
116 *H. engleri* Schinz *Story 5593*
117 *H. erodioides* Kuntze *Schlieben 8861*
118 *H. exilis* Burtt Davy *Dahlstrand 1937*
119 *H. filifolia* L.f. var. *filifolia* *Acocks 15853*
120 *H. filifolia* L.f. var. *grandicalyx* Verdoorn *Bayliss 208*
121 *H. flammea* Jacq. *Dyer 1417*
122 *H. flammula* Harv. *Muir 2157*
123 *H. fruticulosa* K.Schum. *Acocks 15619*
124 *H. gariepina* Eckl. & Zeyh. *Acocks 16360*
125 *H. geniculata* Eckl. & Zeyh. *Flanagan 88*
126 *H. gerrardii* Harv. *Pentz 304*
127 *H. glabrata* L.f. *Flanagan 1356*
128 *H. glanduligera* K.Schum. *Clarke 51*
129 *H. glandulosissima* Engl. *Dinter 8449*
130 *H. gracilis* Eckl. & Zeyh. *Acocks 12044*
131 *H. grandiflora* Ait. *Shearing 128*
132 *H. grandifolia* N.E.Br. *Malan 17*
133 *H. grandistipula* K.Schum. *Tyson 1115*
134 *H. grisea* Schinz *Verdoorn 2510*
135 *H. guerkeana* K.Schum. *Story 4641*
136 *H. helianthemum* K.Schum. *Barnard 111*
137 *H. helicoidea* Verdoorn *Schlechter 5092*
138 *H. heterophylla* (Cav.) Thunb. *Oliver 3799*
139 *H. hispidula* Reichb. *De Winter & Verdoorn 9059A*
140 *H. holosericea* Jacq. *Mauve 4695*
141 *H. hyssopifolia* L. *Acocks 14637*
142 *H. incana* Cav. *Marsh 575*
143 *H. involucrata* Cav. *Acocks 21116*
144 *H. jacobeifolia* R.A.Dyer *Acocks 18428*
145 *H. johanssenii* N.E.Br. *Henrici 3475*
146 *H. joubertiana* Harv. *Sidey 1806*
147 *H. lacera* Fourcade *Galpin 87*
148 *H. lancifolia* Szyszyl. *Sutton 697*
149 *H. lavandulifolia* L. *Marsh 816*
150 *H. leucantha* Schltr. *Schlechter 11456*
151 *H. linearifolia* Harv. *Flanagan 1378*
152 *H. linifolia* Burm.f. *Pillans 3950*
153 *H. linnaeoides* K.Schum. *Brueckner 133*
154 *H. macowanii* (Szyszyl.) Schinz *Hanekom 1535*

155 *Hermannia macra* Schltr. *Van Breda 1332*
156 *H. malvaefolia* N.E.Br. *Killick 1722*
157 *H. marginata* (Turcz.) Pillans *Thode A1883*
158 *H. micrantha* Adamson *Esterhuysen 19251*
159 *H. minimifolia* Holzhammer *Dinter 5164*
160 *H. minutiflora* Engl. *Barker 8316*
161 *H. modesta* (Ehrenb.) Mast. *Leistner 1831*
162 *H. montana* N.E.Br. *Rogers 14709*
163 *H. montana* N.E.Br. *Burtt Davy 446*
164 *H. mucronulata* Turcz. *Story 2611*
165 *H. muirii* Pillans *Bayliss 3774*
166 *H. multiflora* Jacq. *Bos 495*
167 *H. muricata* Eckl. & Zeyh. *Schlieben 12440*
168 *H. oblongifolia* (Harv.) Hochr. *Strey 10645*
169 *H. odorata* Ait. *Acocks 15526*
170 *H. oligosperma* K.Schum. *Esterhuysen 15496*
171 *H. parviflora* (Eckl. & Zeyh.) K.Schum. *Barker 10599*
172 *H. parvula* Burtt Davy *Codd 1137*
173 *H. patellicalyx* Engl. *Dinter 6348*
174 *H. paucifolia* Turcz. *Marloth 5634*
175 *H. pinnata* L. *Marsh 1256*
176 *H. prismatocarpa* E.Mey. ex Harv. *Marsh 1263*
177 *H. pulchella* L.f. *Häfstrom & Acocks 941*
178 *H. pulverata* Andr. *Sim 5635*
179 *H. quartiniana* A.Rich. *Story 4568*
180 *H. rautanenii* Schinz ex K.Schum. *Story 5674*
181 *H. repetenda* Verdoorn *De Winter & Verdoorn 9044*
182 *H. resedifolia* (Burch.) R.A.Dyer *Leistner 898*
183 *H. rigida* Harv. *Ellis & Schlieben 12464*
184 *H. rogersii* Burtt Davy *Rogers 18255*
185 *H. rudis* N.E.Br. *Boucher 500*
186 *H. rugosa* Adamson *Thompson 1758*
187 *H. saccifera* K.Schum. *Mauve 4682*
188 *H. salviifolia* L.f. var. *salviifolia* *Taylor 1463*
189 *H. salviifolia* L.f. var. *oblonga* Harv. *Acocks 21112*
190 *H. sandersoni* Harv. *Medley Wood 4653*
191 *H. scabra* Cav. *Rogers 17055*
192 *H. scordifolia* Jacq. *De Winter & Verdoorn 9045*
193 *H. scordifolia* Jacq. *Thompson 1007*
194 *H. sisymbriifolia* Hochr. *Leistner 421*
195 *H. solaniflora* K.Schum. *De Winter & Hardy 8028*
196 *H. spinosa* E.Mey. ex Harv. *Bayliss 2844*
197 *H. staurostemon* K.Schum. *Junod 17526*
198 *H. stellulata* K.Schum. *Leistner 176*
199 *H. stipulacea* Lehm. *Thompson 952*
200 *H. stricta* (E.Mey. ex Turcz.) Harv. *Hardy 2563*
201 *H. suavis* Presl ex Harv. *Olivier 461*
202 *H. sulcata* Harv. *Robbertse 2*
203 *H. ternifolia* Presl *Gillett 4266*
204 *H. tigrensis* Hochst. in A.Rich. *Tölken & Hardy 772*
205 *H. tomentosa* (Turcz.) Schinz *Leistner 1667*
206 *H. transvaalensis* Schinz *Devenish 367*
207 *H. trifoliata* L. *Acocks 22277*
208 *H. umbratica* Verdoorn *Smith 6153*
209 *H. velutina* DC. *Strey 6712*
210 *H. veronicifolia* (Eckl. & Zeyh.) Hochr. *Sidey 1920*

211 *Hermannia vestita* Thunb. *Cannon 132*
212 *H. viscosa* Hiern *De Winter & Leistner 5691*
213 *H. woodii* Schinz *Trauseld 472*

Tribe: Sterculieae

214 *Cola microcarpa* Brenan *Garland 434*
215 *C. natalensis* Oliv. *Ross & Moll 2291*
216 *Sterculia africana* (Lour.) Fiori *Abner A26*
217 *S. alexandri* Harv. *Schönland 1687*
218 *S. murex* Hemsl. *Codd 6145*
219 *S. quinquiloba* (Garcke) K.Schum. *Volk 2903*
220 *S. rogersii* N.E.Br. *Acocks 23354*

BOMBACACEAE

221 *Adansonia digitata* L. *Mills 260*

MALVACEAE

Tribe: Malopeae

222 *Malope* sp. *Sister Tarcisia 68*

Tribe: Hibisceae

223 *Azanza acutiloba* (Bak.f.) Exell & Mendonca *Stewart 218*
224 *A. garckeana* F.Hoffm. *Codd 6908*
225 *Cienfuegosia digitata* Cav. *Strey 3493*
226 *C. gerrardii* (Harv.) Hochr. *Mauve 4444*
227 *C. hildebrandtii* Garcke *Wells 2048*
228 *Gossypioides kirkii* (Mast.) Hutch. *Strey 6817*
229 *Gossypium anomala* Wawra *Merxmueller & Giess 925*
230 *G. herbaceum* L. var. *africanum* Hutch. & Ghose *Thorncroft 74*
231 *G. triphyllum* (Harv.) Hochr. *De Winter 2675*
232 *Hibiscus aethiopicus* L. var. *ovatus* Harv. *Repton 2752*
233 *H. allenii* Spraque ex Hutch. *Killick & Leistner 3356*
234 *H. altissimus* Hornby *Moll 792*
235 *H. aridus* R.A.Dyer *Britten 5899*
236 *H. articulatus* Hochst. ex A.Rich. *Ulbricht 32164*
237 *H. barbosae* Exell *Thorncroft 4989*
238 *H. caesius* Garcke *De Winter 2756*
239 *H. calyphyllus* Cav. *Meeuse 9741*
240 *H. cannabinus* L. *Codd 5926*
241 *H. castroi* Bak.f. & Exell *De Winter & Leistner 5094*
242 *H. coddii* Exell *Smuts & Gillett 4055*
243 *H. dinteri* Hochr. *Strey 2549*
244 *H. diversifolius* Jacq. subsp. *diversifolius* *Acocks 21673*
245 *H. dongolensis* Del. *Edwards 3259*
246 *H. elliottiae* Harv. *Hardy 2038*
247 *H. engleri* K.Schum. *Van Vuuren 1435*
248 *H. engleri* K.Schum. *Theron 2138*
249 *H. fleckii* Guerke *Volk 2352*
250 *H. fuscus* Garcke *Strey 9022*
251 *H. lobatus* Forsk. *Schlieben 9359*
252 *H. ludwigii* Eckl. & Zeyh. *Archibald 4039*

253 *Hibiscus lunarifolius* Willd. *Meeuse 9809*
254 *H. marlothianus* K.Schum. *Werger 190*
255 *H. mastersianus* Hiern *Scheepers 327*
256 *H. mechowii* Garcke *Merxmueller & Giess 1871*
257 *H. meeusei* Exell *Strey 5727*
258 *H. meyeri* Harv. subsp. *meyeri* *Repton 5975*
259 *H. meyeri* Harv. subsp. *transvaalensis* (Exell) Exell *Van der Schijff 982*
260 *H. micranthus* L. *Leistner 2043*
261 *H. microcarpus* Garke *Guillarmod 4681*
262 *H. mutatus* N.E.Br. *Merxmueller (15.10.1957) s.n.*
263 *H. palmatus* Forsk. *Strey 2625*
264 *H. pedunculatus* L.f. *Strey 6435*
265 *H. physaloides* Guill. & Perr. *Scheepers 633*
266 *H. platycalyx* Mast. *Meeuse & Strey 10459*
267 *H. praeteritus* R.A.Dyer *Strey 3720*
268 *H. pusillus* Thunb. *Dyer 1348*
269 *H. rhabdotospermus* Garcke *Dinter 7513*
270 *H. sabdariffa* L. *Kinges 3422*
271 *H. schinzii* Guerke *Leistner 1692*
272 *H. sidiformis* Baill. *Galpin 12237*
273 *H. subreniformis* Burtt Davy *Strey 3072*
274 *H. sulfuranthus* Ulbr. *Strey 2551*
275 *H. surattensis* L. *Dohse 275*
276 *H. tiliaceus* L. *Edwards 2607*
277 *H. trionum* L. *Taylor 2585*
278 *H. upingtoniae* Guerke *Schoenfelder 559*
279 *H. upingtoniae* Guerke *De Winter 2943*
280 *H. vitifolius* L. subsp. *vitifolius* *Flanagan 1071*
281 *H. vitifolius* L. subsp. *vitifolius* *Pegler 1266*
282 *H. vitifolius* L. subsp. *vulgaris* Brenan & Exell *Meeuse 9731*
283 *H. waterbergensis* Exell *Theron 2137*
284 *Kosteletzkya buettneri* Guerke *Killick & Leistner 3420*

Tribe: Malveae

285 *Lavatera cretica* L. *Acocks 20742*
286 *Malva neglecta* Wallr. *Louw 559*
287 *M. parviflora* L. *Acocks 21816*
288 *M. parviflora* L. *Schmitz 236*
289 *M. pusilla* Sm. *Theron 158*
290 *M. sylvestris* L. *Mostert 995*

Tribe: Abutileae

Subtribe: Abutilinae

291 *Abutilon angulatum* (Guill. et Perr.) Mast. var. *angulatum* *Oates 22*
292 *A. angulatum* (Guill. et Perr.) Mast. var. *microphyllum* (Bak.f.) Hochr. *Boss A40*
293 *A. austro-africanum* Hochr. *Leistner 913*
294 *A. dinteri* Ulbr. *Volk 2438*
295 *A. engleranum* Ulbr. *Dinter 7358*
296 *A. fruticosum* Guill. & Perr. *De Winter & Leistner 5432*
297 *A. galpinii* A.Meeuse *Tinley 512*

298 *Abutilon galpinii* A.Meeuse *Ward 2185*
299 *A. grandifolium* (Willd.) Sweet *Bowker (Sept. 1922) s.n.*
300 *A. grantii* A.Meeuse *Strey 6454*
301 *A. hirtum* (Lam.) Sweet *West 5511*
302 *A. matopense* Gibbs *Meeuse 9792*
303 *A. mauritianum* (Jacq.) Don. *Ward 6301*
304 *A. mendoncae* Bak.f. *De Winter & Leistner 5467*
305 *A. piloso-cinereum* A.Meeuse *Henrici 2008*
306 *A. pycnodon* Hochr. *Leistner 2337*
307 *A. ramosum* Guill. & Perr. *Van der Schijff 2721*
308 *A. rehmannii* Bak.f. *De Winter 2883*
309 *A. sonneratianum* (Cav.) Sweet *Meeuse 9429*
310 *Anisodontea anomala* (Link & Otto) Bates *Hardy 804*
311 *A. biflora* (Desr.) Bates *Esterhuysen 15991*
312 *A. bryoniifolia* (L.) Bates *Leistner 344*
313 *A. capensis* (L.) Bates *Marsh 939*
314 *A. capensis* (L.) Bates *Galpin (9.9.1897) s.n.*
315 *A. elegans* (Cav.) Bates *Theron 2079*
316 *A. julii* (Burch. ex DC.) Bates subsp. *julii* *Ruch 1614*
317 *A. julii* (Burch. ex DC.) Bates subsp. *pannosa* (H.Bol.) Bates *Killick 3854*
318 *A. julii* (Burch. ex. DC.) Bates subsp. *prostrata* (E. Mey. ex. Turcz.) Bates *Flanagan 1506*
319 *A. malvastroides* (Bak.f.) Bates *Theron 618*
320 *A. procumbens* (Harv.) Bates *Bayliss 1173*
321 *A. racemosa* (Harv.) Bates *Thode A2101*
322 *A. scabrosa* (L.) Bates *Taylor 3988*
323 *A. setosa* (Harv.) Bates *Bolus 8413*
324 *A. triloba* (Thunb.) Bates *Olivier 16*
325 *Malveopsis grossulariaefolia* (Cav.) Kuntze *Acocks 23641*
326 *M. scabrosa* (L.) Stapf *Marsh 582*
327 *Sphaeralcea bonariensis* (Cav.) Griseb. *Brueckner 17*
328 *Wissadula rostrata* (Schumach.) Hook.f. *Codd 5343*

Subtribe: Sidinae

329 *Malvastrum coromandelianum* (L.) Garcke *Gerstner 3864*
330 *M. scabrosum* (L.) Stapf *Bos 120*
331 *M. virgatum* Gray & Harv. *Gemmell 5054*
332 *Sida acuta* Burm.f. *Van der Schijff 496*
333 *S. alba* L. *Trauseld 982*
334 *S. chrysantha* Ulbr. *Repton 4776*
335 *S. chrysantha* Ulbr. *Ihlenfeldt 2286*
336 *S. cordifolia* L. *Strey 6565*
337 *S. hoepfneri* Guerke. *De Winter 2904*
338 *S. hoepfneri* Guerke. *Bradfield 164A*
339 *S. hoepfneri* Guerke. *Brueckner 1316*
340 *S. pseudocordifolia* Hochr. *Strey 9785*
341 *S. rhombifolia* L. *Wells 3377*
342 *S. spinosa* L. *Hanekom 1689*
343 *S. ternata* L.f. *Louw 1025*

Tribe: Ureneae

344 *Pavonia burchellii* (DC.) R. A. Dyer *Van Vuuren 515*
345 *P. clathrata* Mast. *De Winter 4320*
346 *P. columella* Cav. *Strey 4158*

347 *Pavonia dentata* Burtt Davy *Meeuse 31266*
348 *P. dregei* Garcke *Scott-Smith 69*
349 *P. elegans* Garcke *Codd 5703*
350 *P. leptocalyx* (Sond.) Ulbr. *Meeuse 9184*
351 *P. praemorsa* Willd. *Sidey 3427*
352 *P. senegalensis* (Cav.) Leistner *Giess 9956*
353 *Radyera urens* (L.f.) Bull. *Banks 103*

2.3 *Acetolysis*

To introduce a common basis for the comparison of pollen from herbarium sheets of varying age, as well as to remove adhering debris, all specimens were acetolysed before examination. In their study of the pollen of the Compositae, Skvarla & Turner (1966) also stress the use of acetolysed pollen for the same reasons.

The acetolysis procedure also causes dehydrated, collapsed pollen grains to resume their normal shape (Ridgway & Skvarla, 1969). Examination of the pollen grains is thus simplified.

The traditional method of acetolysis, as supplied by Erdtman (1960, 1969) was slightly modified for use with small numbers of pollen grains. The complete procedure employed is as follows: Polleniferous parts (usually anthers, but often parts of the floral column, and occasionally complete small flowers), were deposited in rimmed Durham tubes (5 × 30 mm) and covered with the standard acetolysis mixture of 9:1 acetic acid anhydride and concentrated sulphuric acid. The tubes were then heated in a water bath at 95 ° for 5 minutes and thereafter centrifuged at 2 000 × g for 60 minutes. The acetolysis mixture was carefully removed by aspiration with a vacuum needle. Distilled water was added to the pollen in the tubes and the pollen suspended in the water. The tubes were then centrifuged again at 2 000 × g for 10 minutes, after which the water was decanted. The pollen was washed twice more with distilled water (removal of water by decantation after centrifugation) to remove all traces of the acetolysis mixture. This is of great importance if the pollen is subsequently to be examined in the scanning electron microscope. Traces of the reagent cause a visible, unevaporable film to be deposited on the pollen as soon as all the water is removed during vacuum coating. This film obscures the surface detail of the pollen. After the final wash in water, most of the liquid was decanted and the pollen resuspended in the small remaining volume of water in the tube.

As the accepted methods of storage of pollen samples, described by Erdtman (1966), caused contamination of the pollen with adhering glycerin jelly when additional aliquots were needed for electron microscopy, water with a trace of phenol as preservative, was used instead.

It is a well-known fact that pollen grains may swell or distort unpredictably after different preparation techniques have been used (Andersen, 1961;

Erdtman & Praglowski, 1959; Van der Spoel-Walvius & de Vries, 1964) and that different embedding materials may cause the same aberrations. Praglowski (in Erdtman & Praglowski, 1959) points out that swelling of thin-walled pollen, embedded in glycerin jelly, measured over three years, amounts to 3,3 % to 4,3 % if the pollen was not chlorinated after acetolysis. This is not in agreement with the 16 % increase found by Andersen (1961) in the same thin-walled pollen. Thick-walled pollen, however, swells only by 0,7 % to 2,9 % under the same circumstances (Praglowski, 1970).

In the course of this study some pollen grains were measured repeatedly during an interval of approximately three years and only small differences (0,5 % to 1,8 %) were found between the first and last measurements. These aberrations were apparent in the diametrical dimensions of the pollen grains, while no differences were encountered in other structures measured.

The only real alternative to glycerin jelly as a mounting medium, is silicone oil, which has a different index of refraction. This difference allows slightly finer detail to be resolved on the pollen grain (Berglund, Erdtman & Praglowski, 1959). During this survey fine detail was studied by means of the electron microscope, thus the indices of refraction of the embedding media were considered to be of negligible importance. Owing to certain practical advantages, the use of glycerin jelly was therefore preferred.

2.4 *Optical microscopy*

To prepare material for use in the optical microscope, a very small piece (less than 0,5 mm^3) of glycerin jelly was dipped in the pollen suspension in a Durham tube or storage vial and mounted on a microscope slide. After covering the pollen with a coverslip, the jelly was heated to its melting point and the coverslip was ringed with melted paraffin wax to seal the mounted specimens.

Measurements were made with a Zeiss photomicroscope with apochromatic oil-immersion optics and an eyepiece micrometer.

2.5 *Electron microscopy*

To prepare the material for scanning electron microscopy, a small volume of the pollen suspension was deposited on a chemically cleaned electron microscope object carrier and allowed to dry in the air.

Most of the pollen samples were vacuum coated with 40/60 gold/palladium alloy. A few samples were coated with silver, which gave less satisfactory results.

Some pollen grains exhibited exine characteristics which necessitated relatively high-resolution views of the exine as seen in cross section. The resolution required was too high to be attained in optical sections of pollen grains with the light microscope. Instead of preparing thin sections for transmission electron microscopy, object carriers with adhering pollen were pressed against glass microscope slides to crush and shatter some of the pollen grains. The broken edges of these grains could then easilv be studied with the scanning microscope.

2.6 *Acquisition of data*

A certain number of characteristics cannot, or can only with great difficulty be expressed in quantitative form. These characteristics are therefore given in qualitative terms even though this may not be completely desirable for numerical analysis.

2.6.1 *Quantitative measurements*

Optical microscopy

The optical microscope was used to determine the dimensions given below.

a. Polar diameter. This measurement was taken between the outer part of the sexine (sensu Erdtman, 1952) of one pole and the corresponding point on the other pole. In species where the outer surface of the sexine is sinuous due to the presence of spines, the polar diameter was taken between points where the exine appears to be at its thinnest.

b. Equatorial diameter. This dimension was measured in the same way as the polar diameter and in spherical grains was taken as exactly the same as the polar diameter.

c. Length of colpi.

d. Thickness of the exine in the mesocolpial area, measured as near to the equator as possible. In spiny grains this measurement was taken in the area between adjacent spines where the exine is at its thinnest. Measurements of the exine thickness in the different areas of the pollen grain were taken from optical sections.

e. Thickness of the exine at a pore. This measurement represents the apparent thickness of the exine as seen with the optical microscope and does not always correspond well with the same thickness as measured on broken pollen grains observed with the electron microscope.

f. Thickness of the exine in the polar area.

g. The ratio of sexine thickness to nexine thickness (nexine used sensu Erdtman 1952). These dimensions were both measured in the polar region of colpate grains and in the area between adjacent spines in other grains. These values were assigned to one of the following states, each representing a different spread of values for sexine thickness ÷ nexine thickness.

0 : >2
1 : 1,6 – 1,99
2 : 1,2–1,59
3 : 0,8–1,19
4 : 0,5–0,79
5 : 0,3–0,49
6 : <0,29

Scanning electron microscopy

Scanning electron micrographs were printed at known magnifications. The dimensions of structures were measured directly on the prints by means of a vernier gauge and the sizes calculated and expressed in μm.

The following structures were measured.

a. The length of spines or spinules.
b. The basal diameter of spines or spinules.
c. The length of lacunae (the area between the meshes of the reticulum, sensu Erdtman, 1943).
d. The width of the lacunae. When the width and the length of the lacunae were approximately equal, the same size was used for c and d.
e. The diameter of the areolar area at the base of most spines (Fig. 1). In cases where no visible areolus was present, the size used was the same as that of the basal diameter of the spines present.
f. The width of the muri surrounding the lacunae.
g. The number of spines.

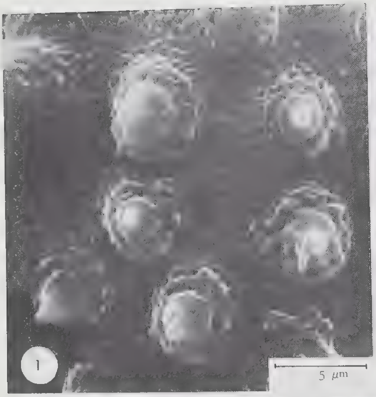
2.6.2 *Qualitative data*

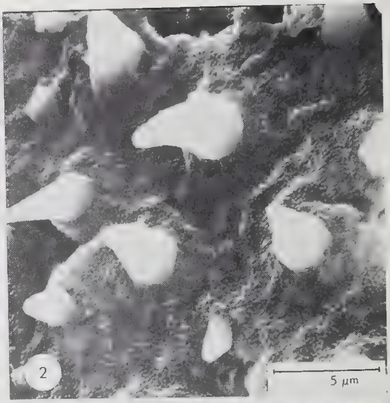
Optical microscopy.

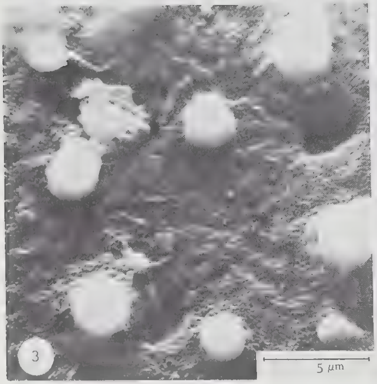
The following data were obtained from studies with the optical microscope.

a. L.O. pattern (the different patterns observed on the pollen surface, obtained by successive focal adjustments of the microscope, Erdtman, 1956). This feature was assigned to one of the following classes, depending on the appearance. O : No L.O. pattern visible. In this class are included the spinose pollen grains where a true L.O. pattern was not visible. A rather coarse pattern, changing in brightness with varying focus, as is the case in normal L.O. patterns, was observed (Fig. 5). This, however, was due to the presence of pits or perforations in the sexine, and is here treated as being distinct from the normal L.O. patterns where baculi contribute to the pattern.

1 : A pilate pattern.
2 : A retipilate pattern.
3 : A reticulate pattern with the muri simplibaculate (Fig. 6).







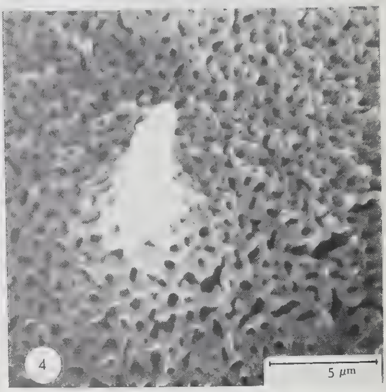


Fig. 1.
Pollen surface of *Abutilon fruticosum* illustrating the areolar area at the base of the spines.

Fig. 2.
Pollen surface of *Malva parviflora* illustrating spinal dimorphism.

Fig. 3.
Sexine surface detail of the pollen of *Malva neglecta*.

Fig. 4.
Sexine surface detail of the pollen of *Melhania forbesii*.

4 : A reticulate pattern with the muri duplibaculate (Fig. 7).
5 : A scrobiculate pattern.
6 : An areolate pattern (Fig. 8).

(The descriptions used for classes 1–6 are according to Erdtman, 1966).

b. Spine shape.

The shape of the tip of the spine was assigned to one of three classes.

0 : No spines present.
1 : Spines blunt.
2 : Spines sharp.

c. Pollen grain colour.

The colour of pollen grains after acetolysis may vary, but pollen grains of a species still tend to be either lighter or darker in colour. The colour observed most often in pollen grains of a given species was thus assigned to one of the following states.

0 : Nearly invisible in transmitted light, due to absence of colour.
1 : Very light in colour.
2 : Light in colour.
3 : Intermediate in colour.
4 : Dark in colour.
5 : Very dark in colour (almost no light transmitted through the grains).

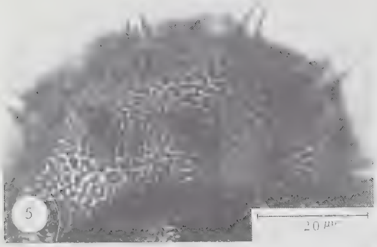
d. The number, position and characteristics of the pores (N.P.C.). These attributes of the pollen grains were assigned to one of the N.P.C. classes as in Erdtman (1969) and Erdtman & Straka (1961). According to this index N may be represented by classes 0 to 8, P may be represented by classes 0 to 6 and C may be represented by classes 0 to 6.

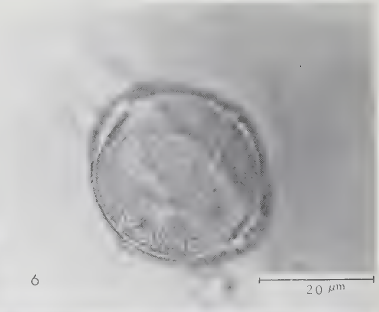
Scanning electron microscopy

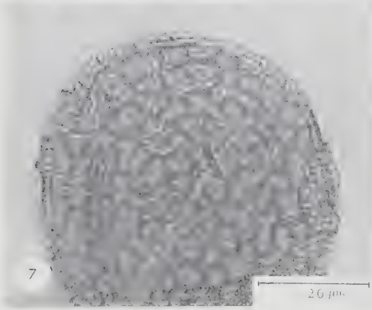
The following data were obtained from the electron micrographs.

a. Dimorphism of spines. This was expressed by assigning the prominence of dimorphism to one of three states.

0 : Was used to indicate that spines were absent or that no dimorphism was observed.
1 : Was used to indicate that weakly developed dimorphism was present.
2 : Denotes that two or more spine types were very prominently displayed (Fig. 2). The presence of microspinulae and spinelike granules were not taken into account in the placement in one of these states.







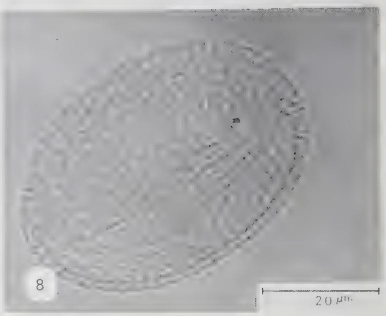


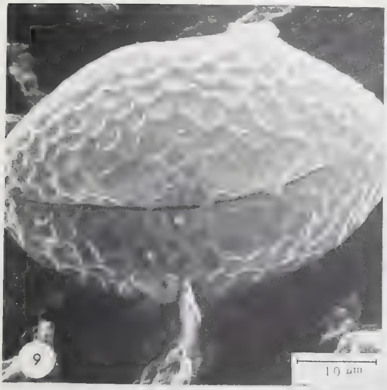
FIG. 5.
The "L.O." pattern on the pollen grain surface of *Melhania acuminata*.

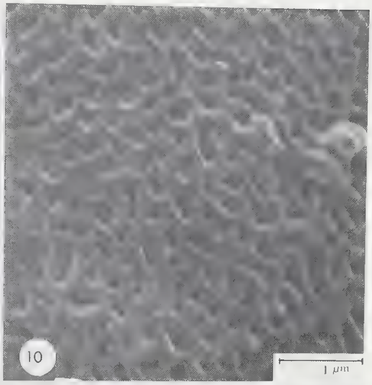
FIG. 6.
The L.O. pattern on the pollen surface of *Hermannia trifoliata*.

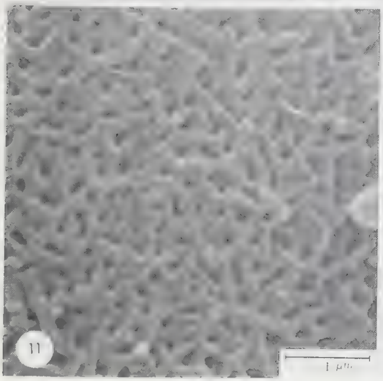
FIG. 7.
The L.O. pattern on the pollen surface of *Grewia avellana*.

FIG. 8.
The L.O. pattern on the pollen surface of *Grewia vernicosa*.

b. The texture of the sexine surface. This variable was expressed by assignment to one of the following states.
   1 : The sexine surface smooth, without pits, warts or granules and with no reticulation.
   2 :The sexine surface rough, without pits or openings other than the pores, with warts or granules, but without any reticulation (Fig. 3).
   3 : The sexine surface as in 1 or 2, but with pits or small openings, without reticulation (Fig. 4).







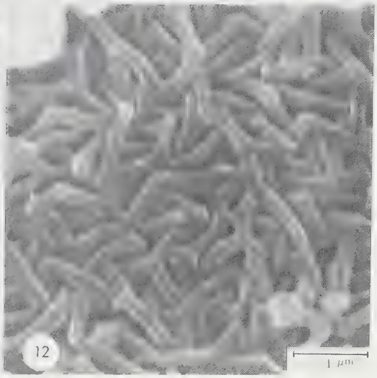


FIG. 9.
Bold reticulation pattern of the sexine of *Grewia occidentalis*.

FIG. 10.
Reticulation pattern and superimposed striations on the sexine of *Hermannia elliottiana*.

FIG. 11.
Reticulation pattern and superimposed striations on the sexine surface of the pollen of *Hermannia desertorum*.

FIG. 12.
Striation pattern on the sexine surface of the pollen of *Hermannia rudis*.

4 : The sexine surface with a barely visible reticulation pattern.
5 : The sexine surface with a bold reticulation pattern (Fig. 9).
6 : The sexine surface with a reticulation pattern and a barely visible superimposed striation pattern (Fig. 10).

7 : The sexine surface with a reticulation pattern (which may vary from clearly to hardly visible) and a superimposed striation pattern (Fig. 11).
8 : Exine surface with a striation pattern only (Fig. 12).

2.6.3 *Computed values*

The maximum and the minimum dimensions of a given quantitative attribute, as observed over all samples of any one species, were also considered to be a characteristic of that species.

The percentage variation of any quantitative characteristic within a species was computed as

$$\frac{\text{max. dimension} - \text{min. dimension}}{\text{min. dimension}} \times 100$$

and could be utilised in the analysis.

The following data groups can be used in the computation of indices of similarity:

1. All data including percentage variation of characteristics used in computation. This method takes into account the measure of specialisation of a taxon, as well as the normal affinities. Taxa with less variation of characteristics are thus grouped together and taxa with a large variation are also grouped together. This data-group was used for interpretative purposes only.
2. All data except percentage variation used in calculations.
3. It must be emphasised that indirect weighting of certain characteristics result from the use of this data as such characteristics are given as separate average, minimum and maximum property-strings. A third data-group was therefore introduced, in which all data except percentage variation, minimum and maximum values and calculated ratios was used.

By comparing dendrograms constructed from data as in (1), (2) and (3), tentative deductions can be made as to the delimitation of taxa.

2.7 *Synoptic list of characteristics useful in pollen analysis*

1. Average polar diameter.
2. Minimum polar diameter.
3. Maximum polar diameter.
4. Percentage variation of polar diameter.
5. Average equatorial diameter.
6. Minimum equatorial diameter.
7. Maximum equatorial diameter.
8. Percentage variation of equatorial diameter.

9. Average spine length.
10. Minimum spine length.
11. Maximum spine length.
12. Percentage variation of spine length.
13. Average number of spines.
14. Average spine diameter.
15. Minimum spine diameter.
16. Maximum spine diameter.
17. Percentage variation of spine diameter.
18. Average length of colpi.
19. Minimum length of colpi.
20. Maximum length of colpi.
21. Percentage variation in length of colpi.
22. Average exine thickness in the mesocolpium.
23. Minimum exine thickness in the mesocolpium.
24. Maximum exine thickness in the mesocolpium.
25. Percentage variation in exine thickness in the mesocolpium.
26. Average exine thickness at a pore.
27. Minimum exine thickness at a pore.
28. Maximum exine thickness at a pore.
29. Percentage variation of exine thickness at a pore.
30. Average exine thickness at the pole.
31. Minimum exine thickness at the pole.
32. Maximum exine thickness at the pole.
33. Percentage variation of exine thickness at the pole.
34. Average lacunar length.
35. Minimum lacunar length.
36. Maximum lacunar length.
37. Percentage variation in lacunar length.
38. Average lacunar width.
39. Minimum lacunar width.
40. Maximum lacunar width.
41. Percentage variation of lacunar width.
42. Average areolar diameter.
43. Minimum areolar diameter.
44. Maximum areolar diameter.
45. Percentage variation of areolar diameter.
46. Average width of muri.
47. Minimum width of muri.
48. Maximum width of muri.
49. Percentage variation of width of muri.

50. $\frac{\text{Areolar diameter}\quad(42)}{\text{spine diameter}\quad(14)}$
51. $\frac{\text{Exine thickness at the pole}\quad(30)}{\text{exine thickness in mesocolpium}\quad(22)}$
52. $\frac{\text{Spine length}\quad(9)}{\text{spine diameter}\quad(14)}$
53. $\frac{\text{Polar diameter}\quad(1)}{\text{colpium length}\quad(18)}$
54. $\frac{\text{Muri width}\quad(46)}{\text{lacuna width}\quad(38)}$
55. $\frac{\text{Lacuna length}\quad(34)}{\text{lacuna width}\quad(38)}$
56. Shape of spine.
57. Texture of exine.
58. L.O. pattern.
59. $\frac{\text{Sexine thickness}}{\text{nexine thickness}}$
60. Colour.
61. Spine dimorphism.
62. Number of apertures (N).
63. Position of apertures (P).
64. Character of apertures (C).

2.8 *Determination of phenetic relationships*

A great variety of different procedures (Sneath & Sokal, 1973, Clifford & Stephenson, 1975) may be employed to determine phenetic relationships (Cain & Harrison, 1960) of different members of a group. A variety of computational methods were used and the results will be presented elsewhere.

3. RESULTS

3.1 *Construction of the key*

The choice between an analytical key and a synoptical key is not straightforward. Both keys have their own inherent advantages and disadvantages. Leenhouts (1966) gave prominence to the impressive advantages of the synoptical key. These advantages are, amongst others, the full use of striking or exclusive characters, the easy delimitation of taxa on account of a combination of characters, the easy mutual comparison of taxa and finally, the high reliability of this method. The disadvantages of the synoptical system are enumerated by Korf (1972). The most important of these is the fact that such a key is cumbersome to use when it incorporates a large number of taxa. This drawback may be minimised when the characteristics are divided into smaller subgroups. If these subgroups are made small enough, the number of species in any one subgroup should not be unmanageable.

The choice of the size of subgroups is not easy, because each size of group chosen must be laboriously sorted by hand. This trial and error method can be extremely time consuming and is always subject to errors.

For this reason a computer program was written which allowed subgroup sizes to be adjusted until the optimum size was reached.

The optimum size depends on the number of taxa incorporated, as well as the ranges of values in each species encountered for any one characteristic. If the spread of values for a characteristic is very large, no purpose is served by choosing very small range subgroups, as these subgroups would contain nearly as many species as larger subgroups. It would, in this case, be disadvantageous to use very small subgroups, as the large number of subgroups more than cancel out the advantage of slightly smaller numbers of species in each group.

The benefits of the synoptical system of identification were, for the purposes of pollen identification, considered greater than the disadvantages, and this system is used here.

One of the primary considerations was the fact that this key may be used with data from optical microscopy only, even though data which may only be obtained with the aid of the scanning electron microscope is also included.

This would not, in most cases, lead the user to the single correct species, but would at least allow him to eliminate a large number of other possibilities. An analytical key to a group such as this would necessitate the use of characteristics obtained from optical and electron microscopy.

Any one species usually appears in more than one subgroup of the quantitative characteristics, because the range of values of the species for that characteristic is usually larger than the value range of the subgroup.

The numbers following each division of a characteristic in the key are the same numbers assigned to the taxa in the list of investigated material.

3.2 KEY

(numbers correspond with those used in the list of investigated taxa)

1. POLAR DIAMETER OF COLPATE POLLEN AND DIAMETER OF PORATE POLLEN

Less than 15,0 μm

76 82 84 87 88 91 93 96 100 108 110 115 116 117 118 123 125 126 127 128 129 131 132 133 134 136 138 144 147 148 150 151 153 154 157 159 161 162 168 172 175 177 179 180 182 184 187 194 195 197 200 204 205 206 208 210 212 213

15,1 to 20,0 μm

75 76 80 82 84 85 87 89 91 92 96 100 103 108 115 116 117 118 124 125 127 133 134 135 138 144 147 148 151 152 160 163 168 171 177 179 182 187 194 195 196 197 198 200 204 205 208 210 211 219

20,1 to 22,5 µm

36 75 77 81 90 93 97 106 111 121 137 139 155 156 160 167 170 171 173 174 178 191
192 213 214 215 219

22,6 to 25,0 µm

79 80 86 99 105 106 107 113 114 119 120 124 135 137 139 140 142 143 145 149 164 165
166 167 170 174 183 186 192 196 203 209 211

25,1 to 27,5 µm

3 7 29 77 81 83 90 94 99 104 109 111 112 120 130 141 152 158 165 169 173 176
178 181 183 185 186 189 190 199 215

27,6 to 30,0 µm

29 43 44 45 48 53 79 97 98 102 107 114 145 149 155 156 188 191 202 207

30,1 to 35,0 µm

3 6 7 10 11 12 35 36 39 42 44 50 54 56 58 78 86 94 101 104 105 109
112 113 130 140 141 142 143 146 158 164 169 176 181 185 193 199 202 214 216 217 218 220

35,1 to 40,0 µm

1 4 5 8 9 10 12 15 21 23 35 47 49 50 52 53 54 55 56 58 59 95
98 102 119 121 122 146 166 190 193 201 203 207 209 216 217 327 343

40,1 to 50,0 µm

2 6 8 9 11 13 14 15 17 19 21 25 30 32 40 42 43 45 46 47 49 51
52 55 57 59 60 62 64 68 78 83 95 101 122 188 189 201 218 286 320 324 327 340

50,1 to 60,0 µm

2 5 16 18 20 22 24 26 27 28 31 34 37 38 40 41 48 51 62 65 68 70
71 72 73 74 221 286 289 298 307 310 311 313 315 325 326 331 334 337 338 339 343

60,1 to 70,0 µm

4 18 19 23 25 26 27 28 30 32 33 34 38 41 57 61 63 64 67 70 71 73
74 231 289 293 294 295 296 298 299 300 302 303 305 307 308 309 310 311 312 313 314 315
318 321 323 330 331 334 335 338 339 341 342

70,1 to 80,0 µm

22 31 37 60 61 63 67 69 224 230 231 237 258 260 287 293 294 295 296 299 300 301
303 308 312 314 318 319 321 323 325 328 332 336 337 340 342

80,1 to 90,0 µm

66 69 223 224 227 229 230 233 237 241 242 246 250 258 259 268 272 274 281 287 290 292
297 301 304 305 309 316 319 329 333 335 341 353

90,1 to 100,0 µm

223 225 226 227 229 233 235 236 238 242 243 246 248 254 260 264 267 272 273 274 278 283
291 306 317 322 329 330 336 348

100,1 to 110,0 µm

234 235 236 239 240 245 248 250 251 255 259 261 263 265 267 268 269 277 278 281 282 283
284 285 297 302 306 316 322 344 347 348 349 350 351 353

110,1 to 120,0 µm

225 226 234 241 245 249 251 253 254 256 262 264 265 266 269 270 271 275 276 277 280 284
285 291 333 349

120,1 to 140,0 µm

222 228 232 238 239 240 243 247 249 252 256 257 261 262 263 266 270 271 273 275 276 279
288 290 345 346 350 351 352

More than 140,1 µm

244 247 253 255 257 279 280 282 288 344 345 346 352

2. EQUATORIAL DIAMETER OF COLPATE POLLEN AND DIAMETER OF PORATE POLLEN

Less than 10,0 µm

82 88 110 128 129 134 136 147 150 157 172 195 208 212

10,1 to 15,0 µm

75 76 80 82 84 85 87 88 89 91 92 93 96 100 103 108 110 115 116 117 118 123
124 125 126 127 128 129 131 132 133 134 135 136 138 144 147 148 150 151 153 154 157 159
160 161 162 163 168 171 172 175 177 179 180 182 184 187 194 195 196 197 198 200 204 205
206 208 210 212 213

15,1 to 20,0 µm

4 6 7 11 29 36 42 43 44 47 48 49 80 81 90 92 93 103 105 106 111 124
135 137 139 144 145 152 155 156 160 167 170 171 173 174 178 179 183 187 191 194 196 198
200 205 211 213 215 219

20,1 to 25,0 µm

1 3 5 8 10 11 12 13 14 15 21 29 43 44 45 50 51 75 77 79 81 83
86 90 97 99 104 106 107 109 111 113 114 119 120 121 137 139 140 141 142 143 149 152
155 164 165 166 167 169 174 176 178 181 183 186 190 192 199 203 207 209 214 219

25,1 to 30,0 µm

2 3 8 9 14 15 17 23 33 35 42 46 47 49 50 52 53 77 78 79 94 95
97 98 102 104 105 107 109 112 113 114 120 130 140 142 143 145 146 149 156 158 169 173
176 181 185 188 189 191 193 199 202 214 215 216

30,1 to 35,0 µm

9 19 21 24 25 27 38 39 40 41 45 51 52 54 56 58 83 86 94 98 101 122
130 141 158 164 185 190 193 202 209 216 217 218 220

35,1 to 40,0 µm

2 4 5 6 13 16 17 20 26 30 33 34 35 37 48 53 54 55 56 58 59 78
95 101 102 119 121 146 166 188 189 201 203 207 217 327 343

40,1 to 50,0 µm

16 18 19 20 22 27 31 32 38 40 55 57 59 60 62 64 68 70 122 201 286 320
324 327 340

50,1 to 60,0 µm

18 22 23 25 26 28 30 31 32 34 37 41 62 65 68 70 71 72 73 74 221 286
289 298 307 310 311 313 315 325 326 331 334 337 338 339 343

60,1 to 70,0 µm

57 61 63 64 66 67 71 73 74 221 231 289 293 294 295 296 298 299 300 302 303 305
307 308 309 310 311 312 313 314 315 318 321 323 330 331 334 335 338 339 341 342

70,1 to 80,0 µm

60 61 63 66 67 69 224 230 231 237 258 260 287 292 293 294 295 296 299 300 301 303
308 312 314 318 319 321 323 325 328 332 336 337 340 342

More than 80,1 µm

69 222 223 224 225 226 227 228 229 230 232 233 234 235 236 237 238 239 240 241 242 243
244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265
266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 287 288
290 291 292 297 301 302 304 305 306 309 316 317 319 322 329 330 333 335 336 341 344 345
346 347 348 349 350 351 352 353

3. LENGTH OF SPINES

Less than 3,0 µm

53 54 55 58 59 60 68 221 286 287 289 296 297 298 310 312 318 319 322 323 324 327
331 337 338 339 340 343

3,1 to 5,0 µm

56 57 58 60 62 63 70 71 72 223 231 254 275 281 288 290 293 294 296 297 299 300
301 304 305 306 307 308 309 310 311 312 313 314 315 316 317 319 320 321 323 325 326 328
329 330 331 332 333 334 335 336 338 339 341 342 343

5,1 to 8,0 µm

57 62 64 65 66 67 68 69 70 71 73 74 223 224 225 226 227 228 229 230 231 237
250 251 252 265 274 285 288 289 291 292 293 294 295 298 299 301 302 303 304 305 306 308
309 311 314 315 318 320 322 324 325 330 332 333 334 336 337 340 341 353

8,1 to 11,0 μm

61 64 65 66 69 73 224 227 230 233 235 238 246 250 251 252 253 254 259 260 265 268
270 271 273 280 281 285 286 287 290 317 344 348 350

11,1 to 14,0 μm

67 222 225 228 232 235 236 238 239 240 241 243 246 249 255 258 261 262 269 272 276 277
278 282 291 346 349

14,1 to 18,0 μm

222 233 237 239 241 242 243 244 245 247 248 249 253 255 256 257 259 263 264 266 267 268
270 271 273 275 276 279 280 283 284 344 346 347 350 351

More than 18,1 μm

232 234 236 240 244 245 248 257 261 262 263 264 266 267 272 277 278 279 282 283
284 345 348 349 351 352

4. NUMBER OF SPINES

Absent

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44
45 46 47 48 49 50 51 52 75 76 77 78 79 80 81 82 83 84 85 86 87 88
89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132
133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154
155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176
177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198
199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220

Spines present, less than 50

61 62 63 69 71 246 267

51 to 100

53 55 56 57 60 64 65 66 67 68 70 72 73 74 227 232 233 234 235 237 238 239
240 241 242 243 245 247 248 252 253 258 259 260 261 262 263 264 266 269 272 273 274 277
278 279 281 282 283 284 291 347 348 349 350 352

101 to 150

54 58 59 223 230 236 244 249 250 251 254 255 256 257 265 268 270 271 275 276 280 292
295 299 302 306 311 315 318 319 321 344 345 351 353

151 to 250

221 222 224 225 226 229 231 289 293 294 296 297 298 300 301 303 304 305 307 308 309 310
313 316 317 320 322 323 325 326 327 330 331 334 335 337 339 343 346

More than 251

228 285 286 287 288 290 312 314 324 328 329 332 333 336 338 340 341 342

5. BASAL DIAMETER OF SPINES

Less than 2,00 μm

53 54 55 56 58 59 68 72 221 275 286 287 288 289 290 296 297 298 299 300 307 308
309 310 311 312 313 314 315 318 319 320 321 322 324 325 327 328 330 331 332 333 334 335
337 339 340 341 343

2,01 to 2,50 μm

55 56 58 62 63 73 229 231 274 281 285 293 294 297 306 307 310 313 316 321 323 324
326 327 329 336 338 340 342 346

2,51 to 3,00 μm

60 64 67 71 72 223 225 250 254 265 280 295 301 303 305 309 312 317 319 320 323 337
338 339

3,01 to 3,50 μm

60 62 63 65 70 74 226 227 237 243 286 287 292 298 303 304 315 325 326 328 332 333
336 342 343 348 353

3,51 to 4,00 μm

57 61 67 69 71 226 231 238 258 260 288 293 294 295 299 300 304 305 308 316 318 335 341

4,01 to 4,50 μm

65 66 70 74 223 224 225 228 229 230 245 246 250 252 259 263 274 283 285 289 290 291 292 296 301 302 311 322 329 334 344

4,51 to 6,00 μm

57 61 64 68 69 73 222 227 232 233 236 238 241 242 247 248 249 251 252 253 255 256 260 261 262 264 269 271 272 277 282 284 302 306 317 330 331 344 347 350 351 353

6,01 to 7,00 μm

224 232 233 235 237 239 240 242 244 246 247 248 249 255 257 258 259 265 266 267 270 271 273 275 276 278 279 280 281 291 345 349 350 352

7,01 to 9,00 μm

66 222 228 230 234 236 241 243 245 251 253 254 256 261 262 264 266 267 268 269 270 272 273 276 277 279 284 346 347 349

More than 9,01 μm

234 239 240 244 257 263 268 278 282 283 345 348 351 352

6. DIMORPHISM OF SPINES

No dimorphism

53 54 56 57 59 60 61 62 63 65 70 71 72 73 74 222 224 225 227 228 233 234 235 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 255 256 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 276 277 278 279 291 293 296 299 301 302 303 304 305 306 307 309 315 319 320 330 336 341 344 345 347 349 350 351 352 353

Weakly developed dimorphism

55 58 64 66 67 69 221 223 226 229 230 231 237 257 274 282 283 284 285 286 288 290 292 294 295 297 298 300 308 310 311 313 314 316 317 318 321 325 326 327 328 329 331 332 333 334 335 337 338 339 340 342 343 346 348

Prominent dimorphism

68 232 236 254 275 280 281 287 289 312 322 323 324

7. SPINE SHAPE

Spines blunt

55 56 57 59 60 61 63 64 65 66 68 69 70 71 72 74 221 226 227 228 229 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 282 283 284 285 286 287 288 289 290 292 296 298 300 301 303 305 306 307 309 319 328 329 330 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353

Spines sharp

53 54 58 62 67 73 223 224 225 230 231 281 291 293 294 295 297 299 302 304 308 310 311 312 313 314 315 316 317 318 320 321 322 323 324 325 326 327 331 332 333

8. DIAMETER OF AREOLUS

Less than 3,0 μm

53 54 55 56 58 59 62 68 71 72 73 221 250 254 280 281 285 286 288 289 290 307 312 321 324 327 337 343 346

3,1 to 4,2 μm

56 57 61 62 63 64 67 69 70 71 74 229 237 243 258 259 274 275 283 286 287 288 297 307 310 311 312 313 314 316 318 320 323 326 327 328 329 330 332 338 339 340 343 348

4,3 to 5,0 μm

57 60 61 63 66 70 72 73 224 246 250 252 255 272 285 287 293 296 299 300 301 303 305 308 309 310 314 315 317 319 320 321 322 324 325 331 333 334 335 336 337 338 340 341 342 350 353

5,1 to 6,0 µm

60 64 65 66 67 68 69 74 223 226 231 233 238 245 252 253 256 264 274 275 282 290
294 295 298 304 311 313 315 322 323 326 328 330 331 339 341 342 347 351

6,1 to 7,0 µm

223 224 225 235 238 241 243 255 258 259 260 262 265 276 279 280 281 289 291 296 302 306
309 316 319 325 329 332 335 345 347 349 350

7,1 to 8,0 µm

65 225 232 237 239 240 246 248 249 253 256 260 265 269 273 277 279 294 297 298 300 303
308 317 318 333 336 344 346 352 353

8,1 to 10,0 µm

226 227 228 229 230 231 233 234 236 239 241 242 244 245 247 251 254 261 262 264 266 268
271 272 273 276 277 283 284 292 293 295 299 301 302 304 305 306 344 345 348 349 351

More than 10,1 µm

222 227 230 232 234 236 240 244 247 248 249 257 261 263 266 267 268 269 270 271 278 282
284 291 334 352

9. LENGTH OF COLPI

Less than 9,0 µm

76 88 91 93 103 108 110 115 118 123 125 128 129 131 134 136 138 150 151 153 157 159
161 172 175 180 182 197 200 204 205 206 212

9,1 to 11,0 µ m

75 82 83 84 88 89 91 92 96 97 100 106 110 115 116 117 118 123 126 127 128 131
132 134 135 136 141 144 147 148 150 153 154 157 159 161 162 165 168 170 174 177 179 180
184 187 194 195 196 206 208 209 210 212 213 214 219

11,1 to 13,0 µm

76 77 80 82 84 85 87 92 100 102 107 108 113 116 117 121 125 126 127 129 132 133
138 141 144 146 147 148 151 154 163 168 178 179 182 187 188 191 198 199 200 202 204 205
208 209 210 215 219

13,1 to 15,0 µm

3 29 75 79 80 81 83 85 86 87 90 94 96 97 99 101 103 104 106 107 111 112
114 119 120 124 130 135 137 139 140 142 143 145 149 152 155 158 160 163 164 165 167 170
171 173 174 176 177 178 181 183 189 190 194 195 196 197 198 202 203 211 213 214 220

15,1 to 17,0 µm

36 45 77 86 89 90 93 95 98 104 109 113 114 130 137 140 143 145 149 152 155 156
166 167 169 173 183 185 186 191 192 193 207 211 215

17,1 to 20,0 µm

7 43 44 78 79 81 94 101 102 105 109 112 120 121 124 139 142 146 156 158 164 166
169 186 190 192 199 201 217 220

20,1 to 25,0 µm

3 6 7 9 10 11 12 26 29 32 35 36 39 48 50 78 95 98 111 185 188 189
193 201 207 216 217

25,1 to 35,0 µm

1 2 4 5 8 9 10 11 13 14 15 17 21 23 25 28 32 35 39 40 42 43
44 45 46 47 49 52 122 216 218

35,1 to 50,0 µm

2 4 5 6 13 15 16 18 19 20 22 24 27 28 30 31 33 34 37 38 40 41
48 51

More than 50,1 µm

18 19 20 22 23 25 26 27 30 31 33 34 37 38 41 51

10. THICKNESS OF THE EXINE AFTER ACETOLYSIS (MEASURED IN THE MESOCOLPIAL AREA OF COLPATE POLLEN AND BETWEEN ADJACENT SPINES IN SPINOSE POLLEN)

Less than 0,6 µm

79 80 96 103 116 121 128 129 134 135 136 142 146 196 205 208 212

0,7 to 0,8 μm

12 36 44 75 76 82 83 87 88 89 91 92 93 98 104 108 110 115 117 123 124 127
128 131 132 133 138 147 150 153 154 159 161 162 166 168 170 171 172 177 179 180 189 192
194 195 197 199 200 201 204 210 212 213

0,9 μm

45 61 75 77 78 80 84 85 86 88 89 90 96 97 98 99 100 102 103 106 107 108
109 110 112 116 118 119 120 121 122 123 124 125 126 129 130 131 132 133 134 135 136 138
139 143 144 148 149 150 151 152 153 154 155 156 157 159 161 163 165 166 168 169 170 174
175 176 178 182 184 187 188 191 193 195 196 198 202 203 204 206 207 208 209 210 221 327

1,0 to 1,1 μm

2 4 12 43 76 77 79 81 83 84 87 90 92 93 94 97 99 100 101 104 106 107
111 112 113 114 115 117 118 119 120 122 127 137 139 140 141 142 143 144 145 147 152 156
158 160 164 167 171 173 174 177 179 180 181 182 183 185 186 187 191 192 194 197 198 200
201 205 209 211 213 304 327

1,2 to 1,3 μm

6 9 14 17 27 29 32 36 48 81 82 86 95 105 109 111 114 140 145 149 165 169
176 189 190 193 202 293 303 308

1,4 to 1,6 μm

7 11 13 16 25 31 32 33 34 44 45 50 53 54 55 74 78 85 91 95 105 113
130 155 181 190 199 207 214 215 309

1,7 to 1,8 μm

1 2 3 5 10 14 15 16 18 21 26 27 29 35 40 41 42 43 46 47 50 52
56 57 58 61 62 94 101 102 141 158 164 185 188 203 220 223 229 296 300 303 305 306
313 314 318 323 324

1,9 to 2,4 μm

1 3 6 7 8 10 11 13 17 20 22 23 31 35 38 41 42 46 47 49 51 52
54 55 56 57 58 59 63 67 69 70 71 214 215 216 218 219 220 230 241 243 295 298
301 302 304 308 313 314

2,5 to 3,0 μm

4 5 9 15 19 20 21 23 30 33 37 38 39 40 48 53 60 64 65 66 67 69
71 72 73 74 216 217 224 231 233 242 251 253 259 260 264 269 291 293 294 296 298 300
301 307 309 310 311 312 318 319 328 329 331 333 334 335 338 343

3,1 to 3,5 μm

8 18 22 24 25 26 30 34 37 51 62 63 68 72 218 227 229 241 245 246 247 262
265 267 268 271 302 306 315 317 319 320 325 330 332 336 340 341 342 353

3,6 to 4,2 μm

24 60 64 65 66 68 70 224 226 227 230 231 233 234 236 238 242 243 249 250 252 255
258 259 260 264 265 268 273 279 291 297 299 307 311 312 316 317 321 322 323 325 326 329
330 331 332 334 338 339 340 343 344

4,3 to 5,0 μm

19 28 223 228 232 235 236 237 239 247 248 251 252 253 256 261 262 267 269 271 274 275
276 283 292 294 295 305 310 316 320 321 322 326 328 333 335 336 337 339 341 353

More than 5,1 μm

28 222 225 226 228 232 234 235 237 238 239 240 244 245 246 248 249 250 254 255 256 257
258 261 263 266 270 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288
289 290 292 297 299 315 337 342 344 345 346 347 348 349 350 351 352

11. APERTURAL THICKNESS OF THE EXINE OF COLPATE POLLEN AFTER ACETOLYSIS

Less than 1,6 μm

36 80 84 88 89 108 125 127 128 129 134 136 157 161 172 180 195 196 199 204 205
208 212

1,7 to 1,8 μm

76 80 82 84 87 100 104 108 110 123 126 127 132 133 138 147 150 151 153 154 157 159
162 168 175 177 179 182 184 196 197 200 206 208 210 212

1,9 to 2,3 μm

41 50 75 76 87 89 91 96 97 98 100 103 104 110 113 115 116 117 121 123 125 126
129 133 134 135 136 138 148 151 152 153 154 161 162 163 170 177 178 179 180 193 194 195
197 204 205 206 209 210

2,4 to 2,7 μm

1 6 9 12 22 41 43 46 47 75 79 81 86 90 92 93 97 99 106 107 114 116
118 119 120 122 124 131 137 139 140 143 146 149 152 155 160 165 166 169 170 174 178 182
183 186 188 191 194 198 200 202 211 213 214 220

2,8 to 3,2 μm

3 25 29 31 32 35 39 42 47 48 50 78 81 85 86 91 92 93 96 98 101 102
111 115 117 118 130 135 137 139 141 142 143 144 145 164 171 176 186 187 189 190 192 193
198 203 213 215 219

3,3 to 3,8 μm

1 2 4 5 8 10 11 14 25 29 45 46 77 90 94 99 101 102 103 105 109 111
112 114 121 122 124 130 140 141 144 149 155 156 158 167 169 173 176 183 185 187 192 202
209 219

3,9 to 4,5 μm

3 6 7 9 10 11 13 15 16 17 27 30 31 35 37 38 39 42 43 44 51 52
77 79 85 94 105 109 112 113 142 156 158 164 171 173 188 189 190 199 201 207 215 216
217

4,6 to 5,5 μm

2 7 13 14 15 18 21 24 27 30 32 33 37 38 45 49 51 52 78 83 95 166
181 185 201 203 207

More than 5,6 μm

4 5 8 16 18 19 20 21 22 23 24 26 28 33 34 40 48 49 83 95 181 218

12. POLAR THICKNESS OF THE EXINE OF COLPATE POLLEN AFTER ACETOLYSIS

Less than 0,7 μm

36 80 83 91 96 103 115 116 121 122 124 128 134 135 136 142 146 166 172 177 195 196
199 201 205

0,8 μm

12 75 76 79 88 98 104 123 129 131 153 170 171 172 180 192 194 197 200 212

0,9 μm

75 77 80 82 84 86 87 88 89 90 92 93 94 97 100 101 102 106 107 108 110 112
117 118 119 120 125 126 128 132 133 134 136 138 143 144 147 148 149 150 151 152 157 159
161 162 165 168 169 170 174 175 178 179 184 187 189 191 195 196 197 203 204 206 208 209
210 212 213

1,0 to 1,1 μm

12 76 78 84 85 87 89 92 93 96 97 98 99 100 103 104 106 107 108 109 110 111
113 114 115 116 117 120 123 124 126 127 129 130 131 132 133 135 137 138 139 140 141 142
143 145 147 152 153 154 155 156 158 160 161 163 164 165 167 168 173 174 176 177 179 180
181 182 183 185 186 188 191 192 193 194 198 200 201 202 204 205 207 208 210 211 213

1,2 to 1,6 μm

4 6 16 29 34 36 38 43 44 45 47 77 79 81 82 83 85 86 90 91 95 99
101 105 109 111 112 113 114 118 121 122 127 137 140 144 145 149 156 167 169 171 176 181
182 187 189 190 193 199 207 209 214 215

1,7 to 1,9 μm

1 2 3 5 9 10 11 13 14 15 17 18 23 25 26 27 30 41 42 43 44 48
50 78 94 95 102 130 141 155 158 164 166 185 188 190 202 203 219 220

2,0 to 2,5 μm

6 7 8 9 15 18 20 21 22 27 29 31 32 33 35 37 40 41 42 46 49 51
52 214 215 216 219 220

More than 2,6 μm

1 2 3 4 5 8 10 11 13 14 16 17 19 20 21 22 23 24 25 26 28 30
31 32 33 34 35 37 38 39 40 45 46 47 48 51 216 217 218

13. LENGTH OF LACUNAE

Less than 0,10 μm

75 80 87 91 98 101 102 105 108 109 113 115 133 140 143 144 145 147 151 152 155 167 176 180 181 183 186 194 213

0,11 to 0,13 μm

76 79 81 84 85 90 92 94 97 104 110 117 118 123 124 126 127 130 131 132 137 139 142 149 154 157 160 165 166 168 174 178 179 185 189 190 191 195 196 198 199 200 201 202 209 210 211

0,14 to 0,16 μm

77 83 86 89 100 103 106 111 112 114 116 136 138 148 156 158 159 164 169 171 172 177 182 184 187 188 203 204 206 208 212

0,17 to 0,25 μm

49 78 91 93 95 96 107 119 120 125 128 134 135 137 141 150 151 152 153 161 162 163 170 173 175 186 192 193 197 205

0,26 to 0,35 μm

41 51 75 80 82 85 90 94 102 104 105 110 111 114 118 122 123 129 142 146 150 153 156 166 180 191 199 202 207 208 214

0,36 to 0,45 μm

3 11 42 43 49 79 81 84 86 87 88 92 93 98 99 108 109 113 115 116 127 128 143 154 155 159 161 162 167 173 175 178 179 182 187 194 196 201 205 206 210

0,46 to 0,60 μm

9 44 45 48 50 52 76 82 88 89 95 96 99 106 107 112 119 120 121 124 125 129 130 131 134 135 136 138 139 140 145 147 148 157 158 160 164 165 168 171 172 174 176 177 183 184 189 192 195 203 209 211 212 215 219

0,61 to 1,00 μm

1 2 4 7 10 12 14 17 21 25 26 29 33 35 40 46 77 78 83 97 100 101 103 117 121 122 126 132 133 141 144 146 149 163 169 170 181 185 188 190 193 197 198 200 204 207 213 216

1,01 to 2,00 μm

3 5 6 7 8 9 12 13 14 15 16 17 20 21 22 23 24 27 28 30 31 34 35 36 37 39 40 42 43 44 47 50 51 52 214 215 217 218 219 220

More than 2,01 μm

1 2 4 5 6 8 10 11 13 15 18 19 20 22 23 24 25 26 27 28 29 30 31 32 33 34 36 37 38 39 41 45 46 48 216 220

14. WIDTH OF LACUNAE

Less than 0,07 μm

85 87 90 91 92 93 98 102 105 106 110 118 126 133 144 145 147 152 160 167 172 173 183 192 198 208 211 213

0,08 to 0,10 μm

75 80 81 84 97 100 101 107 108 109 111 112 113 115 117 125 127 137 138 140 150 151 153 155 157 165 168 170 174 176 177 178 180 181 182 184 186 187 190 191 193 194 197 210

0,11 to 0,15 μm

9 49 76 79 85 86 89 94 103 104 105 116 123 124 130 131 132 136 139 142 143 148 149 154 156 158 159 162 163 166 169 173 175 179 185 188 189 191 192 195 196 199 200 201 202 203 206 209 212 215

0,16 to 0,19 μm

75 77 78 82 83 87 88 90 91 92 95 96 98 106 110 111 114 121 135 150 152 156 160 164 171 174 186 190 193 203 204 210

0,20 to 0,24 μm

49 81 84 93 108 112 119 120 128 134 136 137 141 144 147 148 151 153 154 161 167 172 179 183 184 187 198 205 208 211 214

0,25 to 0,30 µm

4 8 51 76 82 89 94 104 107 117 118 125 126 127 132 133 138 145 157 162 165 166
171 175 177 178 180 182 197 199 207 212 213 216

0,31 to 0,40 µm

2 7 13 41 47 80 88 97 99 102 109 113 114 116 122 123 129 142 143 146 159 161
163 168 170 196 202 206 217

0,41 to 0,50 µm

3 10 11 12 15 23 29 37 42 43 46 48 79 86 95 96 100 115 124 128 129 134
135 139 155 158 176 189 194 195 201 205 207 209 215 219

0,51 to 0,70 µm

1 5 6 7 9 14 16 17 21 33 44 45 50 52 77 78 99 101 103 119 120 121
130 131 140 141 164 181 204 214 220

0,71 to 1,50 µm

1 2 3 4 5 6 8 10 12 13 14 15 16 19 20 21 22 23 24 25 26 29
30 35 36 38 40 42 46 47 50 52 83 122 146 149 169 185 188 200 216 217 218 219
220

More than 1,51 µm

11 17 18 19 20 22 24 25 26 27 28 30 31 32 33 34 35 36 37 38 39 40
41 43 44 45 48 51

15. WIDTH OF MURI

Less than 0,08 µm

49 84 88 93 98 111 118 129 144 147 153 156 171 179 182 187 213

0,09 to 0,11 µm

9 75 76 80 85 87 90 92 103 105 106 108 110 114 116 117 133 134 143 145 148 151
152 160 161 162 167 168 170 172 173 174 177 183 190 192 193 195 196 197 198 204 205 208
211 212

0,12 to 0,14 µm

8 78 81 86 88 89 91 94 95 96 97 100 101 102 109 118 119 122 123 124 125 126
127 128 129 132 135 136 137 138 142 150 153 154 155 157 159 165 169 175 176 180 184 186
191 206 209 211

0,15 to 0,17 µm

2 4 5 10 46 52 77 79 82 83 85 87 92 99 107 111 112 115 120 130 131 136
139 140 150 158 160 162 163 164 167 171 174 176 178 179 181 187 190 192 194 197 198 199
201 202 206 208 210 212 213

0,18 to 0,20 µm

1 7 8 11 17 30 42 47 48 49 51 75 76 80 82 84 93 94 98 99 104 105
110 113 116 117 121 126 135 137 138 139 143 144 145 148 149 152 155 156 159 161 163 166
168 172 175 180 182 185 191 193 200 202 203 204 205 210

0,21 to 0,25 µm

1 2 6 7 10 11 13 14 15 23 33 41 78 81 86 89 90 96 100 103 106 108
109 115 120 122 123 124 125 128 130 131 133 134 140 141 142 146 151 154 157 158 173 177
181 183 184 188 189 194 195 196 201 207 209

0,26 to 0,30 µm

3 4 12 13 14 20 22 24 29 44 45 50 83 95 101 107 114 121 127 132 146 147
149 165 170 178 185 186 199 218 219

0,31 to 0,40 µm

3 5 12 15 16 17 19 20 23 26 35 40 43 45 50 77 79 97 102 104 112 113
119 166 169 188 200 207 214 216 220

0,41 to 0,75 µm

6 9 16 18 19 21 22 24 25 27 28 29 31 32 33 34 35 36 37 38 39 40
41 42 43 44 46 47 48 51 52 91 141 164 189 203 214 215 216 217 218 219 220

More than 0,76 µm

18 25 26 27 28 30 31 32 34 36 37 38 39 215 217

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REPUBLIC OF SOUTH AFRICA

16. TEXTURE OF SEXINE SURFACE

Rough, without pits or reticulation pattern, but with warts or granules

222 232 237 240 246 268 270 278 286 287 288 314

Rough, without reticulation pattern, but with pits and warts or granules

53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
221 223 224 225 226 227 228 229 230 231 233 234 235 236 238 239 241 242 243 244 245 247
248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 269 271
272 273 274 275 276 277 279 280 281 282 283 284 285 289 290 291 292 293 294 295 296 297
298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 315 316 317 318 319 320
321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342
343 344 345 346 347 348 349 350 351 352 353

With barely visible reticulation pattern

39

With bold reticulation pattern

1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 40 41 42 43 44 45 46
47 48 49 50 51 52 76 80 82 83 87 88 91 92 93 97 100 107 108 114 117 118
119 121 127 128 132 133 135 138 143 144 147 148 150 151 153 154 156 159 161 165 170 171
175 179 180 182 187 188 189 194 195 196 198 200 202 203 204 205 212 213 214 215 216 217
218 219 220

With reticulation pattern and barely visible superimposed striations

3 75 77 78 84 86 89 101 102 103 104 110 111 112 113 115 116 120 123 124 125 126
129 130 131 134 136 137 139 140 141 142 145 149 157 158 162 163 164 166 168 169 172 177
178 181 183 184 186 191 193 197 199 201 206 207 208 209 210 211

With reticulation pattern and superimpsed striations

79 81 85 90 94 95 96 98 105 109 146 152 155 160 167 173 174 176 192

Striation pattern only

99 106 122 185 190

17. L.O. PATTERN

None visible

9 16 20 23 25 26 34 35 36 38 39 43 51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 85 86 88 90 91 92 132
146 190 193 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241
242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263
264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285
286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307
308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329
330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351
352 353

Retipilate

3

Reticulate, muri simplibaculate

1 2 4 5 6 7 8 10 11 12 13 14 15 17 24 29 32 41 42 44 45 46
47 48 49 50 76 77 78 79 80 81 82 83 84 87 89 93 94 95 96 97 98 99
100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121
122 123 124 125 126 127 128 129 130 131 133 134 135 136 137 138 139 140 141 142 143 144
145 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167
168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189
191 192 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213
214 215 216 219 221 222

Reticulate, muri duplibaculate

18 19 21 22 27 28 31 33 37 218 220

Areolate

40 217

18. SEXINE THICKNESS ÷ NEXINE THICKNESS

More than 2,0

9 13 14 16 17 19 21 22 25 26 27 28 30 32 33 34 35 37 38 40 41 42
43 44 45 46 47 48 49 50 51 52 57 69 70 74 75 76 77 79 80 82 84 85
86 87 88 89 90 91 92 96 98 100 102 103 105 107 110 112 113 115 117 118 120 121
123 125 126 127 128 129 130 131 132 133 136 137 139 141 143 144 146 149 150 151 152 154
155 156 160 162 164 165 167 168 169 171 172 173 174 175 176 177 178 180 181 183 184 185
186 191 192 194 197 200 201 202 204 208 211 212

1,6 to 1,99

2 5 7 8 11 15 20 23 24 29 31 36 63 66 67 78 81 83 93 94 95 97
99 101 104 106 108 109 111 116 119 122 124 134 135 138 140 142 145 147 148 153 157 158
159 161 163 166 170 179 182 187 188 189 190 193 195 196 198 199 203 205 206 207 209 210
213 214 215 216 217 218 219 220 301 304

1,2 to 1,59

3 6 10 12 18 39 62 71 114 224 226 274 296 298 300 302 307 313 314 315 316 317
319 322 325 328 331 334

0,8 to 1,19

1 4 55 56 58 59 60 65 68 72 73 221 223 225 227 228 229 230 231 232 234 235
236 237 238 242 245 248 249 251 252 253 254 256 258 259 260 265 268 269 270 271 273 275
276 277 278 279 280 291 293 295 297 299 303 305 306 308 309 310 311 312 318 320 323 324
326 327 329 330 332 333 335 336 337 338 339 340 341 342 343 353

0,5 to 0,79

53 54 61 64 222 232 233 239 240 241 243 244 247 250 255 263 264 266 267 272 286 290
292 294 344 348

0,3 to 0,49

246 257 261 262 281 282 283 284 285 287 288 289 321 345 346 347 349 350 351 352

19. COLOUR OF POLLEN AFTER ACETOLYSIS

Extremely light, nearly invisible in transmitted light

31 34 122 232 249 252

Very light

2 9 13 20 36 40 45 48 66 70 80 82 86 92 93 103 118 124 146 171 193 198
205 208 209 226 247 253 265 267 279 286 288 294 297 307 316 317 319 322 335 336 344 351

Light

5 8 11 14 15 16 17 22 23 25 26 27 30 33 35 37 38 39 41 46 51 62
63 75 76 78 79 81 84 85 87 89 90 91 94 95 96 98 99 101 102 108 109 110
112 114 115 116 117 125 126 127 128 131 132 133 134 135 136 138 140 142 144 145 147 148
149 151 153 154 155 156 157 159 160 162 163 166 168 170 175 176 177 179 180 181 182 185
187 189 192 194 195 196 197 203 210 212 213 225 228 238 241 243 245 296 312 313 321 327
346 350

Intermediate

1 3 4 6 12 19 21 29 32 42 44 47 49 50 54 55 56 58 59 61 68 69
72 77 83 88 97 100 104 105 106 107 111 119 120 121 123 129 130 137 139 141 143 150
152 158 161 164 165 167 169 172 173 174 178 183 184 186 188 190 191 199 200 201 202 204
206 207 211 214 215 216 221 222 223 224 229 231 233 242 244 246 248 250 251 259 260 261
262 269 271 273 274 275 285 287 291 292 295 298 300 302 303 305 306 308 309 311 314 315
318 323 324 325 328 329 330 331 333 334 338 343

Dark

7 10 18 24 28 43 52 53 57 60 64 65 71 73 74 113 217 218 219 220 227 230
234 235 237 239 254 256 257 258 263 268 270 276 277 278 282 283 289 293 299 301 304 310
320 326 332 337 339 340 341 342 345

Very dark, almost opaque

67 236 240 255 264 266 272 280 281 284 290 347 348 349 352 353

20. N.P.C. (Number, position and character of apertures)

344

53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
221

345

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
23 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
46 47 48 50 51 52 75 76 78 79 80 81 82 83 84 85 87 88 89 91 92 93
94 96 97 100 101 103 104 105 108 110 111 113 114 115 116 117 118 119 120 121 122 123
124 125 126 127 128 129 130 131 132 133 134 135 136 138 140 141 143 144 146 147 148 149
150 151 152 153 154 156 157 159 160 161 162 163 165 168 169 170 171 172 175 177 178 179
180 182 184 187 188 189 192 193 194 195 196 197 198 200 201 204 205 206 208 209 210 211
212 213 214 216 217 218 219 220

445

24 77 86 90 95 98 99 102 106 107 109 112 137 139 142 145 155 158 164 166 167 173
174 176 181 183 185 186 190 191 199 202 203 207 215

764

222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243
244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265
266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287
288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309
310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331
332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353

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